MISSOURI resources

Spring / Summer 2012 • Volume 29 • Number 2

director's comment

It's springtime in Missouri. The trees are budding, the wildflowers are blooming, the fish are biting and Missouri State Parks is calling your name. I recently enjoyed casting my line at Roaring River State Park and hope to visit Bennett Spring and Montauk state parks in the near future.

In addition to fishing, there are plenty of opportunities to spend time in our state parks and historic sites. If you're looking for a way to enjoy a sunny Saturday afternoon this spring, why not step outdoors for a wildflower hike scheduled in many of our state parks? Visitors will see fields of wildflowers displaying the vibrant colors of their petals and will smell their sweet aroma as it drifts across fields. The world is changing color every day as the spring season continues to evolve.

This year marks the 95th birthday since the Missouri General Assembly created the state park system back in 1917. We know visitors love our state parks and historic sites, which is why they were ranked as one of the top four state park systems in the country by the National Recreation and Parks Association. Additionally, About.com selected Missouri as the number one state for camping in the U.S., making our parks an ultimate destination for your next camping experience.

Recently, we implemented a new Camp Smart program within our state parks and historic sites in an effort to minimize energy consumption. These efforts will be pivotal in keeping costs down and integral to the mission of the department. Energy use is a significant cost to operate Missouri state parks. By reducing one of our biggest expenses, we are leading the way to a brighter future for our beloved parks.

In this issue of Missouri Resources, *you can learn more about energy efficiency, Camp Smart and the About.com award. So, gather up your fishing, hiking and camping gear and make plans today to explore and celebrate our Missouri state parks.*

Sara Parker Pauley

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Missouri Department of Natural Resources

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Mission Statement
The mission of the Missouri Department of Natural Resources
is to protect, preserve and enhance Missouri's natural, cultural and energy resources.

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MISSOURI
DEPARTMENT OF
NATURAL RESOURCES

Above: At Mark Twain State Park, visitors can enjoy recreational activities such as water skiing, swimming, fishing, boating and camping.
Front Cover: Watkins Woolen Mill State Historic Site is the only completely intact 19th-century American woolen mill in the country.
Back Cover: This photo illustration shows what Missouri's state dinosaur, ***Hypsibema missouriensis***, may have looked like during the late Cretaceous period, the end of the age of dinosaurs. The original, life-size model was created by Guy Darrough of Lost World Studios.
DNR photos by Scott Myers.

SMALL STEPS; BIG REWARDS

by Dalena Hardy photographs by Scott Myers

It takes a lot of energy to make food for Fido. Leading pet food provider, Nestlé Purina PetCare Company knows this all too well. The firm has 23 factories in North America and global sales of $12.5 billion. Nestlé Purina PetCare may be big, but it thinks even bigger. Its St. Louis-area facility uses nearly 30 million kilowatt hours of electricity each year – a statistic that never goes unnoticed, or unchallenged.

Utility costs are typically the third highest expense for manufacturers and for most, energy usage is a fixed cost. Clearly, savings from energy-efficiency efforts go straight to the bottom line. Nestlé Purina group maintenance manager, Vincent Jalinsky, has been leading energy-efficiency efforts at Nestlé's St. Louis facility for nearly 20 years, helping the firm reduce its energy consumption by three percent each year.

"It has taken a lot of work to get where we are at now," said Jalinsky. "The last couple of years, it is becoming harder for us because we have already addressed the obvious in energy-efficiency upgrades. We now have to think outside the box and validate our process by hiring third-party auditors who can provide fresh perspective."

Jeff Silkman knows that energy usage impacts his company's future. Silkman is an engineer at Moly-Cop, an Australian-based company with a manufacturing facility in Kansas City. Moly-Cop makes a diverse range of steel products for use in the mining, construction, manufacturing, housing and agricultural industries around the world. Moly-Cop has operations in 15 countries with more than 70 facilities.

Moly-Cop's annual Kansas City product output is 130,000 tons per year, and that requires a lot of electricity. The facility uses more than 190,000 kwh each day – enough energy to provide electricity to more than 16 residential homes for a year.

(Above) Newly forged grinding balls move along the production line at Moly-Cop's Kansas City production facility.

"For the steel industry, energy is a major component in the cost to produce every ton of product we sell," said Silkman. "In order to remain competitive in a truly global marketplace, we must pay close attention to energy costs and do all we can to improve energy efficiency. Good energy efficiency is key to our survival."

The U.S. manufacturing sector accounts for nearly 60 percent of the nation's gross domestic product (GDP) and accounts for nearly 12 percent of the American workforce. Changes in the global economy and upticks in energy prices have many manufacturers in search of funding opportunities that will support energy-efficiency upgrades and retrofits sooner, rather than later.

The Missouri Department of Natural Resources' Division of Energy designed the Energize Missouri Industries program to meet the needs of these industrial facilities. With funding from the American Recovery and Reinvestment Act of 2009, the department has provided more than $5.6 million in grant funding to 35 industrial companies for energy-efficiency and conservation projects, and held the nation's first reverse energy auction for energy efficiency.

(Above) Bin Wu, Ph.D., professor of industrial engineering at the University of Missouri-Columbia and director of the university's Industrial Assessment Center, performs an energy audit with his team of students at O'Fallon Casting Co.

"Based on the cases we've seen, there are ample low-hanging fruit energy upgrades that companies can pursue. . . . "It is simply irresponsible for companies not to pursue efficiency."

- Dr. Bin Wu, MoIAC Director, University of Missouri-Columbia

Moly-Cop and Nestlé Purina are among several Missouri manufacturers that have taken advantage of the Energize Missouri Industries Program.

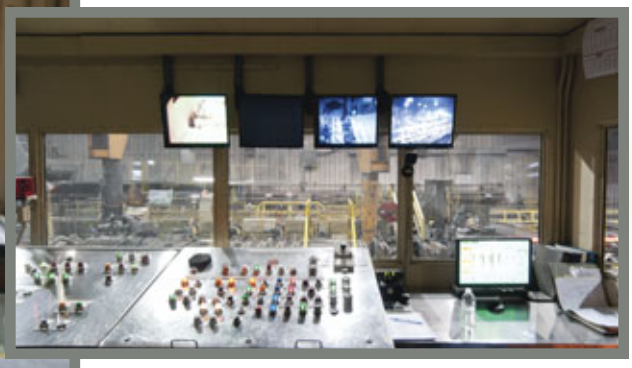
Silkman and his team at Moly-Cop received a postcard in the mail advertising the funding program and decided they could leverage the grant to replace an oversized heat exchanger, which qualified as an energy-efficiency upgrade. The new recuperator has been in service since fall 2011 and Moly-Cop reports an average weekly natural gas reduction of nearly 8 percent. With current gas prices, Moly-Cop expects annual savings of $55,000 from this upgrade.

For Nestlé Purina, the Energize Missouri Industries program helped them pursue efficiency projects already outlined in their company's energy plan. The pet care firm used their grant funds to upgrade a boiler and retrofit a research facility.

Jalinsky and his team expect to save more than 12,000 MMBtu (million Btu) per year on the boiler project alone. The 2 million kwh saved is enough electricity to power 172 residential homes for a year.

In July 2010, 23 companies with Missouri facilities competed in the nation's first reverse auction held for energy efficiency. The firms competed to provide the greatest energy savings at the lowest public cost. The online reverse auction allowed prequalified providers to bid on $2.8 million in incentives on a $/kwh saved basis for expected energy-efficiency projects. Available incentive dollars were allocated based on a lowest-price obtained.

The overall goal of the online auction was to provide industries and commercial entities with the opportunity to realize measurable energy savings that will result in reduced energy costs and increased market competitiveness. The 14 reverse auction winners identified their own industrial and

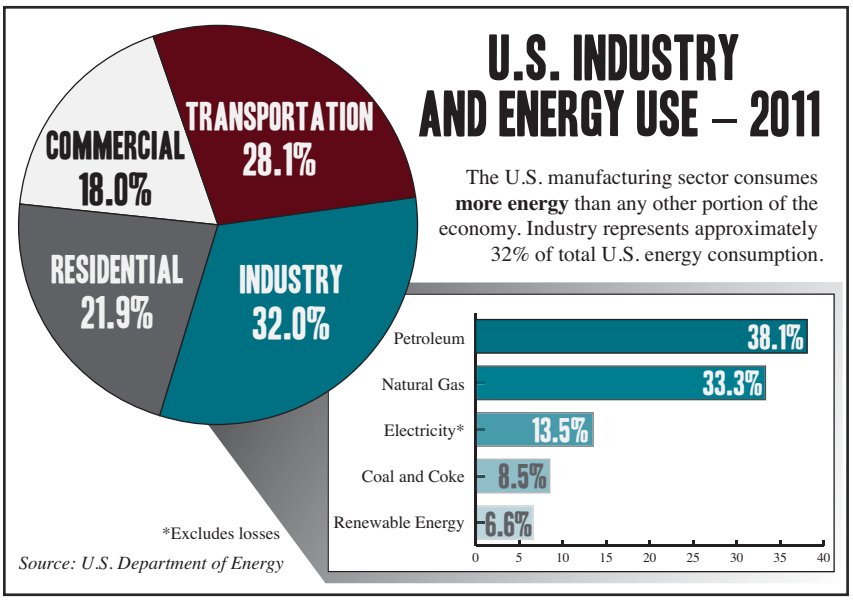


(Above) Steven Ornduff, president of Moly-Cop USA, monitors production in the control room at their Kansas City facility. Moly-Cop produces grinding media that are used by the mining industry. (Opposite page) New boilers at Nestlé Purina PetCare, St. Louis, are expected to save more than 2 million kwh per year.

commercial customers for implementing energy-efficiency projects to expend their allotment of incentive funds and fulfill their energy-savings obligation.

"This has never been done before and it was very exciting to participate," said Tom Ries, president of Innovative Facility Solutions. "Our knee-jerk reaction was to bid as low as we could, but we had to keep feasibility in mind throughout the auction."

Innovative Facility Solutions, an energy-efficiency consultant in St. Louis, was one of eight winners to receive a $100,000 grant. Four companies received $250,000 grants and two companies were awarded $500,000 grants. When all of the winners fully implement the programs for their industrial and commercial customers, Missouri can save up to 75 million kwh of energy, equivalent to powering 6,537 homes for a year, or taking 10,299 cars off the road for a year. Ries' winning bid was $0.095/kwh for a projected total of 1.1 million kwh saved. The company leveraged the $100,000 grant to complete lighting upgrade projects at the St. Louis Post-Dispatch, St. Louis Food Bank, Neighborhood Inc. and Port Industries. The projects are complete and the expected energy savings have been achieved.



Exchanging ideas, learning about new technologies and best practices is paramount as companies pursue energy-efficiency opportunities.

The department, in partnership with the U.S. Department of Energy's Midwest States Save Energy Now program and the Energy Resources Center at the University of Illinois-Chicago, organized the Energize Missouri Industries Energy Efficiency Forum in July 2011 to showcase this need.

"Companies are aware that energy efficiency is a long-term investment in their future. They conduct research and find out what other companies are doing. Forums like this are great because it brings everyone together," said Henry Kurth, associate director of the Energy Resources Center.

Kurth and DOE held similar forums in Iowa, Illinois, Minnesota and Michigan.

"Missouri did an excellent job in using the stimulus funding and the division has been very proactive in ensuring projects are completed and energy savings are achieved," Kurth said.

Educating a new generation of energy professionals was a key topic at the forum. More than 500,000 energy professionals are expected to retire by 2017.

The University of Missouri's Industrial Assessment Center (MoIAC), funded by DOE, is working with DNR and other stakeholders to fill this gap by educating students and helping Missouri manufacturing facilities become more energy efficient.

During the next five years, the MoIAC intends to send teams of professors and students to 150 facilities to conduct energy-efficiency audits that will result in annual savings of more than $70,000 per facility.

"Based on the cases we've seen, there are ample low-hanging fruit energy upgrades that companies can pursue. The immediate impact of our energy audits of companies is substantial – $80,000 a year in energy savings is really equal to $800,000 a year in new sales, assuming an average profit margin of ten percent," said Dr. Bin Wu, director of MoIAC and a professor of industrial engineering at the University of Missouri-Columbia. "It is simply irresponsible for companies not to pursue efficiency."

Wu reports that his graduating students are now leading energy efforts for their employers.

By strategically incorporating energy-efficiency improvements into production and business planning, Missouri manufacturers are increasing cost savings and raising productivity. These improvements also enhance their competitiveness throughout the global marketplace.

Dalena Hardy is a former division information officer for the department's Division of Energy.

ENERGIZE MISSOURI INDUSTRIES RECIPIENTS

AWARDS FOR ENERGY-EFFICIENCY PROJECTS

	ABB Inc.	**$49,500**
	Able Manufacturing	**$104,127**
	AC Buckhorn LLC	**$159,859**
	Anheuser-Busch Inc.	**$750,000**
	Bodine Aluminum Inc.	**$605,000**
	Boulevard Brewing Co.	**$91,948**
	Buchheit Inc.	**$40,196**
	Buckman USA	**$45,261**
*	Cascades Plastics Inc.	**$71,000**
	Continental Casting LLC	**$123,850**
	Continental Cement Co.	**$50,000**
*	Covidien Pharmaceuticals	**$578,481**
	Dura Automotive Systems	**$15,000**
	Elantas PDG Inc.	**$46,480**
	Everlast Sports Mfg. Corp.	**$12,000**
	Family Center Warehouse	**$8,912**
	Henniges Automotive	**$53,379**
*	Hubbell Power Systems	**$148,014**
	Insteel Industries Inc.	**$71,672**
	K&S Wire Products Inc.	**$10,264**
	LMC Industries	**$50,000**
	Mississippi Lime Co.	**$355,254**
	Missouri Plating Co.	**$112,479**
*	Nestlé Purina PetCare	**$636,214**
*	New World Pasta	**$562,647**
	Noranda Aluminum Inc.	**$50,000**
	Moly-Cop	**$250,000**
	Rexam Food Containers	**$53,000**
	Sigma-Aldrich	**$50,000**
	Springfield Remanufacturing Corp.	**$30,000**
	SSM DePaul Health Center	**$318,887**
	Standard Transportation Services	**$19,237**
	Thorco Industries	**$15,000**
*	Unilever	**$30,000**
	R.R. Donnelley	**$49,500**

**Company received two awards*

ENERGIZE MISSOURI REVERSE AUCTION WINNERS

AWARDS FOR ENERGY-USE REDUCTIONS FOR INDUSTRIAL AND COMMERCIAL CUSTOMERS

$500,000 Awards
- Ameren Missouri, $0.0325/kwh
- The Gasket Guy dba Green Energy Masters, $0.0325/kwh

$250,000 Awards
- 8760 Energy Engineering LLC, $0.0294/kwh
- Eco Engineering LLC, $0.0299/kwh
- Missouri Enterprise, $0.0275/kwh
- Murphy Company Mechanical Contractors, $0.0275/kwh

$100,000 Awards
- HTE Technologies, $0.0900/kwh
- Innovative Facilities Solutions, $0.095/kwh
- Schaeffer Marketing Group Inc., $0.100/kwh
- Ozark Energy Services, $0.1050/kwh
- Energy Solutions Inc., $0.1050/kwh
- Zeller Technologies Inc., $0.1098/kwh
- Metropolitan Energy Center, $0.1100/kwh
- Blue Sky Lighting Products LLC, $0.1100/kwh

The Value of Geologic Mapping

by Joe Gillman
photographs by Scott Myers

Geologist Fletcher Bone, with the department's Division of Geology and Land Survey, takes notes during a site visit to an area near Finger Lakes State Park in Boone County.

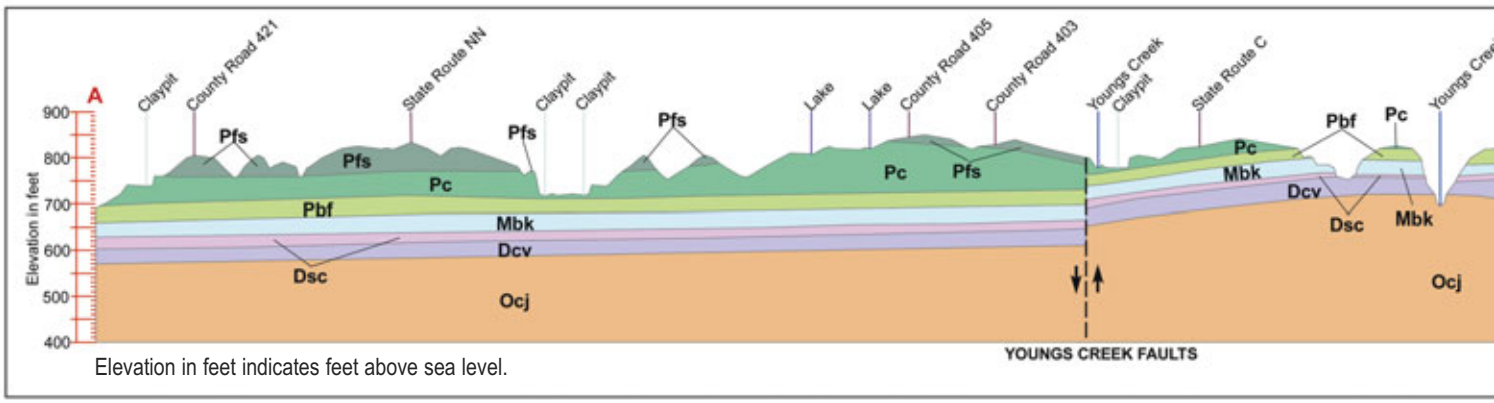
Since 1993, the division has participated in the National Cooperative Geologic Mapping Program to produce state-of-the-art geologic map products. These efforts have the potential for producing nearly $200 million in economic value for Missouri.

Geologic maps are graphic tools that use lines, colors, and symbols to provide an interpretive, three-dimensional view of the rock, sediment and soil that make up our environment. These maps, produced by the department's Division of Geology and Land Survey, depict rock type, distribution, properties and its relative age. They provide information about the Earth's structure and provide a baseline for data related to energy resources, mineral resources, natural hazards, water resources, soil conservation and climate science. Virtually all mineral, energy, water, industrial construction, public works and urban development projects can benefit from a geologic map.

The information contained on a geologic map can be used to characterize the geology of a location within the context of a surrounding region. Scientists can then use this information to construct a predictive model not only of that location, but also of the surrounding regions where similar data may be limited or unavailable.

This allows map users to make informed decisions based on scientific data. For example, geologic maps can help engineers and planners identify surface and rock materials that will provide suitable foundations for the construction of bridges, dams, tunnels, pipelines and highways. Geologic map-based information is essential to the

Cross-Section of Bedrock Geologic Map of Fulton, Mo.



This portion of the cross section from the Bedrock Geologic Map of Fulton shows a vertical slice of the Earth. It identifies different rock formations, landscape topography, and depicts time periods by showing the sequence of sedimentary rocks. The oldest rocks are on the bottom and the youngest on top.

evaluation of the vulnerability of watersheds to contamination. Missouri's geology is complex, and understanding the geology of a particular watershed provides the foundational quantitative attributes of the character and nature of the materials in the subsurface. Interpretation of a particular watershed's geologic characteristics can indicate the nature of the surface water or groundwater interaction and its vulnerability to contaminants. It can identify the occurrence of mineral or energy resources that may one day be of interest for development and thus require approaches that ensure sustainable protection.

These maps also can help landowners, farmers and government agencies locate and protect groundwater resources. They create a regional picture of the geologic materials that store groundwater or provide recharge to groundwater aquifers.

"Geologic maps are the foundation of America's infrastructure," said Kevin Evans, Ph.D. and associate professor of geology with Missouri State University in Springfield. "If it weren't for bedrock and surficial sediment maps, some bridges and buildings could be at risk of collapse, and poorly positioned sanitary landfills could spoil our safe drinking water. One such catastrophe is too many."

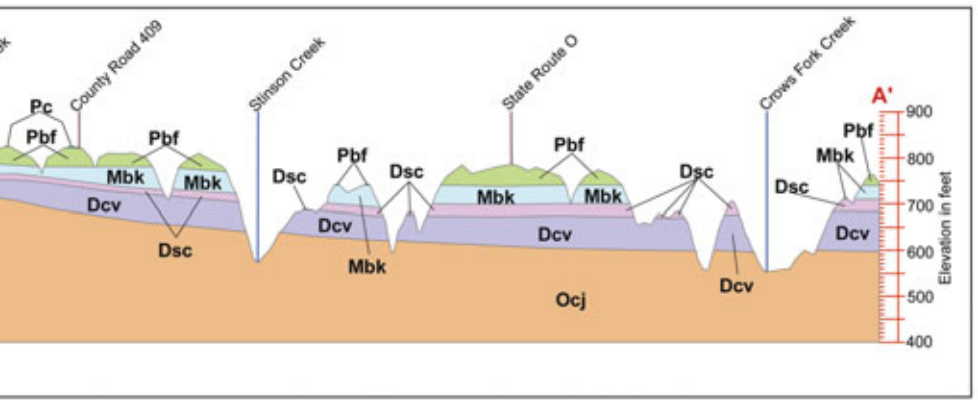
Quality geologic mapping reduces uncertainty and leads to the informed application of regulatory rules that protect the environment and human health. Identifying geologic conditions such as subsurface faulting, high permeability bedrock and areas susceptible to geologic hazards can help eliminate locations being considered for solid waste or wastewater treatment facilities.

Derivative maps also can be generated from geologic maps by extracting selected information or by expanding on the primary data of a specific issue. Maps that show areas prone to karst development, erosion or landslides can reduce the risk associated with the construction of homes, businesses and transportation routes.

In addition, detailed geologic maps allow scientists to generate seismic hazard maps that show geologic materials that are likely to shake during an earthquake.

Geologic maps also help define the occurrence and distribution of energy and mineral resources and help determine strategies for development and environmental protection. They also provide information used to advance strategies of economic development based on the geologic conditions. The maps also have a considerable economic, societal and scientific value. Cost-benefit studies show that the value of a geologic map is 25 to 39 times the cost to produce the map, and developers and engineers can save about $50,000 per project when modern geologic maps are available.

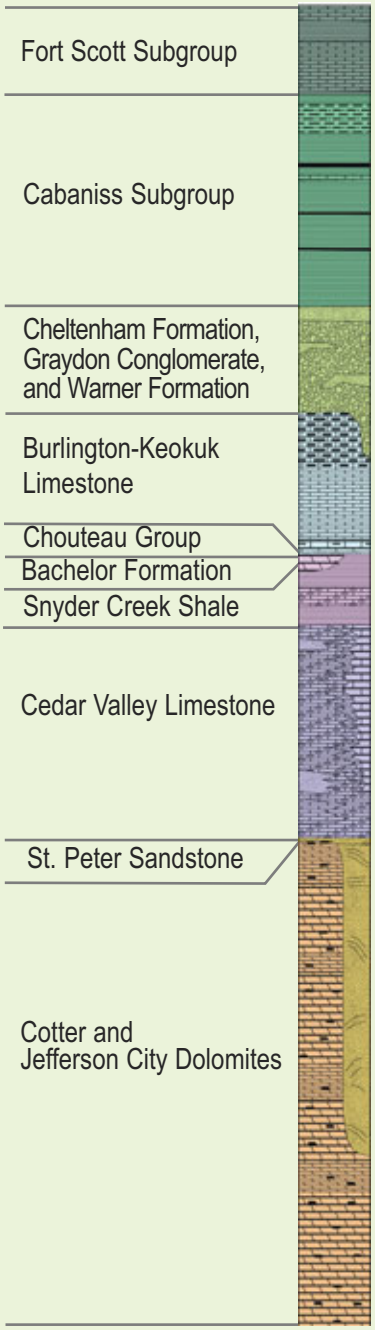
Joe Gillman is director of the department's Division of Geology and Land Survey and serves as state geologist for Missouri.



DNR map by DGLS Geological Survey Program

Pfs, Pc, Pbf = Carboniferous Period (Pennsylvanian Subsystem)
Mbk = Carboniferous Period (Mississippian Subsystem)
Dsc and Dcv = Devonian Period
Osp and Ocj = Ordovician Period

Bedrock Geologic Map of Fulton, Mo.



DNR map by DGLS Geological Survey Program

This portion of the stratigraphic column from the Bedrock Geologic Map of Fulton identifies different rock formations and depicts time periods by showing the sequence of sedimentary rocks. At the top is the Fort Scott Subgroup (youngest), which is composed of limestone. Older cherty clay, sandstone, refractory clay, coal, sand, pyrite, other limestone and various deposits lie between it and the Cotter and Jefferson City Dolomites (oldest) at the bottom of the column. The graphic covers approximately 500 feet in depth. See an online, detailed map at dnr.mo.gov/geology/statemap/stLouis/OFM-07-523-GS.htm.

OPERATION EFFICIENCY

BUILDING A GREENER MILITARY

by Dalena Hardy

U.S. Air Force photo

Whiteman Air Force Base personnel replace damaged and outdated insulation on steam heat distribution pipes. This upgrade resulted in considerable energy savings.

As the nation's largest energy user, the Department of Defense (DoD) is exploring a wide range of innovations to enhance energy security and improve operation effectiveness. Chief among these efforts is deploying energy-efficient and renewable-energy technologies at military bases worldwide.

Today, DoD is undertaking aggressive energy-efficiency goals that are enforced by federal executive orders and legislation.

Executive Order 13423 (2007) requires federal agencies to reduce energy intensity by three percent annually or 30 percent by the end of fiscal 2015, as compared to a fiscal 2003 baseline. Agencies also must reduce their vehicle fleets' total consumption of petroleum by two percent annually through the end of fiscal 2015 as compared to fiscal 2005. The Energy Independence and Security Act of 2007 requires federal facilities to reduce total energy use by 30 percent by calendar year 2015.

The National Defense Authorization Act of 2010 requires DoD to produce or procure 25 percent of its total facility energy use from renewable sources beginning in 2025. Energy professionals have been gearing up.

"I made a binder of all the legislation, executive orders and memos and it has gotten pretty thick," said Amy Crews, environmental engineer at Fort Leonard Wood Army Post. "Honestly, it took us some time to get our heads around it all."

Fort Leonard Wood, located in south-central Missouri, is a thriving installation that has evolved from a small basic training post 70 years ago, to a state-of-the-art, U.S. Army-designated Center of Excellence. The Fort trains nearly 90,000 military personnel and civilians each year. One of the leading employers and the economic engine for the region, it employs more than 9,000 DoD personnel, contractors and other civilians.

"We only have so much space given to us," said Crews. "Fifty-plus years from now we will still be using this land to train, therefore, we take stewardship very seriously."

Fort Leonard Wood teamed up with the U.S. Army Corps of Engineers to design and construct the Prime Power School which trains soldiers to install, operate and maintain medium-voltage electrical power plants. The Prime Power School is FLW's first Leadership in Energy and Environmen-

U.S. Air Force photo/Kenny Holston

tal Design, or LEED® building. The post is required to build new facilities to at least the standards of the LEED Silver designation, but were able to attain Gold, one level higher. LEED is a point-based system in which building projects earn LEED points for satisfying specific green building criteria.

Fort Leonard Wood has incorporated sustainable features into existing facilities through its Energy Saving Performance Contract (ESPC). This agreement provides third-party financing to conduct energy projects with the guarantee that a project's cost will be paid for by its energy savings.

Fort Leonard Wood's ESPC projects have included lighting upgrades, low-consumption appliances and enhanced heating and air conditioning units. Through these projects, FLW will save more than $36 million over the 20-year contract period.

Not to be outdone, the Air Force's energy-efficiency efforts have also taken flight in Missouri. It is attempting to reduce energy consumption, increase energy supply and educate base personnel on being an energy-conserving community.

The overarching goal of Whiteman Air Force Base, located in west-central Missouri, is committed to reducing energy consumption, improving infrastructure and providing mission support. Whiteman currently is home to the 509th Bomb Wing and is the only home air force base for the B-2 Advanced Technology Bomber.

"When we are given direction, we use our resources to ensure that everything gets done," said 1st Lt. Rachel Savage, public affairs deputy for the 509th Bomb Wing.

While the base is committed to DoD energy goals, the growth of the base and size of its mission makes cutting 30 percent of energy use by 2015 a possible, but difficult task.

Whiteman implemented a $15.2 million energy program last year, the largest in Air Force Global Strike Command, which is composed of five bases. In 2010, the base executed $12.4 million in energy projects with an estimated annual utility savings of $1.1 million by 2012.

To reduce energy demand, Whiteman has upgraded or replaced old, inefficient light fixtures and exchanged high-voltage bulbs with energy-efficient versions, among other upgrades. Recently, the base installed new hangar door seals on 21 structures. The anticipated annual savings from the door seals alone equals 6,700 kwh and a savings of nearly $150,000 per year.

Energy remains a key strategic consideration for the Department of Defense, and Missouri's military bases are doing their part to increase efficiency and cut energy costs and consumption.

Dalena Hardy is a former division information officer for the Department of Natural Resources' Division of Energy.

DNR photo by Scott Myers

(Top) Home to the Air Force's fleet of B-2 Stealth Bombers, Whiteman replaced the enormous door seals on hangars, resulting in nearly $150,000 annual energy cost savings. (Above) Because of its energy-efficient, sustainable design, the Prime Power School facility at Fort Leonard Wood was awarded a LEED® Gold designation.

Fountains of Tru

by Kerry Cordray
photographs by Scott Myers

(Right) While it may not look the part, this stone observation shelter at Bennett Spring State Park is also an active water monitoring gauge. (Opposite page) A stream gauge also is located on the Meramec River in Montauk State Park, a popular and historic destination for trout fishermen.

Within just a few miles of virtually every Missouri reader of this article, there is a small array of equipment, an observation station actively tracking the rise and fall of a local groundwater or stream level. A water level reading, often along with a measurement of local rainfall or other weather data, is logged every 30 minutes on each station's small computer module. The data are then transmitted by a small UHF radio unit to a satellite in geostationary orbit 26,000 miles above the equator. The information is then beamed to Earth, received at a station in Little Rock, Ark. operated by the U.S. Geological Survey.

The USGS feeds all readings into a computer, where they are translated into tables and graphic displays and posted on the Internet. Whether the data are being measured at the local observation station or directed to a display on the Web, the chain of events takes only a few seconds.

In Missouri, more than 400 stations make up the network of groundwater observation stations and river and stream gauges that help state and local authorities understand and manage our water resources. All the groundwater monitoring stations are operated and maintained by staff of the Missouri Department of Natural Resources' Water Resources Center. The USGS and other federal, state, municipal and local partners maintain the stream observation gauges.

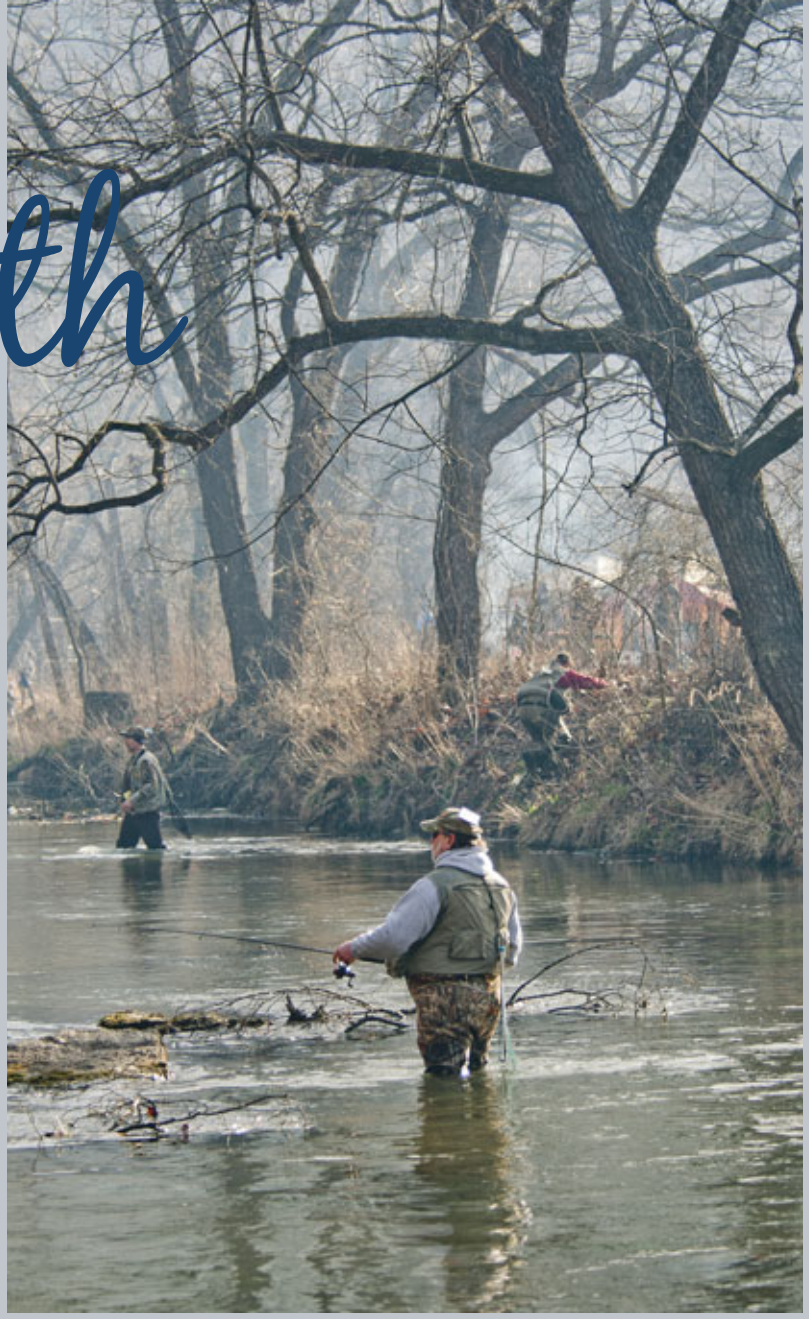
Watching the Water

Why is there such an organized effort to take regular measurements of Missouri's water resources at so many locations around the state? Compared to many other states, Missouri has vast amounts of surface water and underground water resources. But these resources are not infinite.

"Good management and stewardship of any resource starts with good science, including an accurate measurement of the resource over time – knowing how much there is, how and where it is distributed, and how much is being used," said Ryan Mueller, director of the department's Water Resources Center.

Stream gauges track the depth of rivers and streams, ranging from those on the Missouri and Mississippi rivers to numerous smaller rivers and streams across the state.

"The National Weather Service relies heavily on stream gauge information to issue flood watches, warnings and forecasts on major rivers and streams," said Mueller. "River forecasters combine river stage information with the amount of anticipated



rain [in order] to model when and how quickly rivers will rise or fall. Stream gauges are then used to verify the actual river stages so future flood forecasts can be prepared and issued."

The department provides funding to operate 43 of the 254 stream gauges statewide. This includes gauges located at Bennett Spring, Montauk and Roaring River state parks. Those three gauges provide current stream information that helps anglers, campers, floaters and other visitors plan for their outdoor experiences. The state park gauges also collect flow measurements from the large springs feeding the parks' recreational streams. These data help hydrologists learn how spring flow responds to precipitation.

Measuring the Unseen

Keeping track of river and stream levels is essential, but it's equally important to increase our understanding of Missouri's vital groundwater resources. Total groundwater use in Missouri may easily exceed 350 billion gallons of water per year. More than 80 percent of Missouri's public water supplies use groundwater, and it supplies nearly all of Missouri's rural residents who use individual private water supplies.

Most of Missouri's groundwater monitors measure a depth from the land surface down to groundwater using a mechanical system involving a float, a stainless steel tape, pulleys, counterweights and a digital encoder to record the up-and-down movements of the float. The equipment is powered by batteries that are recharged by the sun through a photovoltaic panel. A few of the wells record their data using equipment that translates a water pressure reading from below the surface of the groundwater into a depth measurement.

The monitors are installed in wells, measuring the levels in aquifers that range from less than 30 feet down, to deeper bedrock aquifers more than 1,800 feet deep. Of the 164 current groundwater monitoring wells, 10 were drilled by the department specifically to track groundwater levels near areas of increased water use. But most groundwater monitoring wells were once local wells. These wells were loaned or donated to the department by cities, rural water districts and other landowners who no longer needed them for supplying water.

Making sure all those groundwater monitors run "ship shape" is a large part of the job of Scotty Baumgartner, a Water Resources Center hydrologist.

"We visit each site twice a year for regular scheduled maintenance and calibration.

(Below) A stream gauge monitors the water level from the bridge over Huzzah Creek in Crawford County. (Bottom) Richard Bates of the department's Water Resources Center inspects a water monitoring well at the Eagle Bluffs Conservation Area in Boone County.

Sites with rain gauges get two additional visits a year for cleaning," said Baumgartner. "In addition, we know within one to four hours if one of our stations has malfunctioned. Those sites receive immediate attention to ensure that we collect high-quality, complete data sets."

Adding to the established monitoring networks, in 2009 and 2010 the department installed and began operating monitoring stations at six wetland sites. Two of the sites are in Pershing and Van Meter state parks, while the others are in state conservation areas. Funded by a U.S. Environmental Protection Agency grant and in cooperation with the University of Missouri, the sites are part of a special study to help scientists understand the relationships between water levels, soil conditions and other conditions in Missouri's wetland systems. Data about groundwater, rainfall and other weather conditions from these sites will continue to be monitored and made available after the study is concluded.

From Decent Data to Sound Science

Among the miracles of the information age, massive amounts of water resource data are now instantly available in nearly real-time form via the Web. Major water users like irrigators and industries concerned with availability of water from their wells may see level fluctuations and how quickly or slowly the aquifer that supplies them recharges. Municipalities can adjust the schedules and distribution of their pumping for drinking water supplies. Even paddling enthusiasts can check stream forecasts to see if waters are rising or falling before scheduling an upcoming float.

For online maps and links to stream gauges, groundwater monitors and other water resource information, visit DNR's website at: www.dnr.mo.gov/env/wrc.

Even more importantly, having useful information about our water resources is the first step toward helpful science. Scientists such as hydrologists, geologists and meteorologists use these data many ways.

"The public is most immediately interested in rising or falling waters when we go through the extremes of flooding or drought," said department hydrologist Charlie DuCharme. "But having the data is just as important when we study longer-term future water supplies and needs."

The department's Water Resources Center uses the data as it works with regional planning organizations and water commissions to help them develop long-term, sustainable water supplies critical for the social and economic well being of Missourians. Since the droughts of 2003 and 2005, groups in several areas of the state have studied water supplies and water usage as they considered how to manage regional water supplies and planned to meet anticipated future needs.

A regional group called the Tri-State Water Resource Coalition, formed in southwest Missouri, northeast Oklahoma and southeast Kansas, has performed a series of studies since 2003, investigating potential water sources to meet the needs of its member communities.

Across a 12-county swath of northwest Missouri, county and municipal representatives banded together in 2006 to develop a

regional water supply plan for the area. That partnership incorporated in 2009 as the Great Northwest Wholesale Water Commission, and began to plan a pipeline transmission system to move water from the Missouri River to communities across that 12-county region.

"Many rural communities need expensive water system replacements, and those that are operating their own water supplies often cannot get through a dry spell longer than two years," said Steve McIntosh, an environmental manager for the department. "Interconnections and regional water systems are a critical need for rural drinking water and community fire protection."

(Top right) Richard Bates calibrates a monitoring well data recorder.
(Above) Bates and Scotty Baumgartner, also with the Water Resources Center, measure the groundwater depth at another monitoring well in Columbia.

Delving Deeper

"The advances in monitoring and modeling capabilities provide us better data for water supply planning and decision making," said Mueller. "But a gap still exists in understanding how much water is used, from what areas, over what time periods and for what purposes."

To fill this gap, the Water Resources Center collects and uses data about water use. Missouri law requires any water user with the capability to withdraw 70 gallons per minute or greater from any water source (100,000 gallons per day) to register with the department and to report their water use each year. The data reported help researchers study changes and impacts to Missouri's water resources.

"Reporting water use also helps the individual water users, helping them identify unintended overuse or water losses that may cause increased energy use and higher costs for system maintenance or treatment," said Mueller. "Reporting water use helps document the water needs of the users during times of shortage or dispute – or if there should come a time when water use becomes regulated."

Should that day arrive, it is comforting to know that these Fountains of Truth are sources of more than just water. They are, in fact, in-depth reporters.

Kerry Cordray is a division information officer for DNR's Water Resources Center and Soil and Water Conservation Program.

newsbriefs

Missouri Voted Top State for Camping

The people have spoken: Missouri is the No. 1 state for camping in the U.S. About.com, a reference website maintained by the New York Times Company, announced the results of its annual Readers' Choice Award for Favorite State for Camping, and Missouri took top honors. Missouri took the website's gold award. The silver winner was Montana and bronze went to Colorado, in an online vote.

"The First Lady and I are proud that Missouri has been selected as a renowned camping destination," Gov. Jay Nixon said. "Missouri is the perfect place to enjoy the great outdoors."

"This is yet another solid indicator that Missouri State Parks is the ultimate destination for your next camping experience," said Bill Bryan, director of Missouri State Parks, a division of the Department of Natural Resources. "Our parks and historic sites offer an impressive glimpse of the natural and cultural beauty throughout our state."

Now in its fifth year, the About.com Readers' Choice Awards honor the best products, features and services across more than a dozen categories, ranging from technology to hobbies to parenting and more, as selected by its readers. "This year's Readers' Choice Awards program had a record number of nominations submitted across dozens of categories and featured hundreds of finalists," said Margot Weiss, managing editor, About.com. "We are thankful to all our readers for their participation and congratulate Missouri on their success."

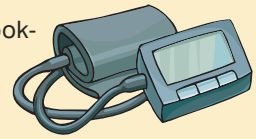
StormAware Website Launched

The State Emergency Management Agency announced the launch of a new website to help inform and prepare Missourians for severe weather. StormAware includes detailed videos on how to take shelter in specific types of buildings, important information about tornado sirens and weather alert radios, and links to severe weather texting services that can alert people across Missouri to upcoming severe weather.

"We think Missouri StormAware will be a valuable tool to educate all Missourians about the steps they can take to help protect themselves from dangerous severe weather," State Emergency Management Agency Director Paul D. Parmenter said.

The text messaging services, which are not provided by the State of Missouri, are free, but normal text messaging rates will apply. For more information, visit the StormAware website at stormaware.mo.gov.

Mercury Roundup Time Ends Soon!

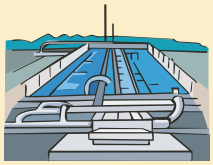


Homeowners looking for a safe way to rid their homes of mercury have until the end of May to take advantage of the Missouri Department of Natural Resources' mercury roundup.

Working with 50 fire departments and county health offices throughout the state, the department is providing mercury drop-off locations in communities statewide. Any private citizen or nonprofit agency can leave mercury-containing instruments, such as thermometers, blood pressure cuffs, thermostats or switches, at any of these sites. Citizens seeking to dispose of items at these sites should first secure the item in two zip top plastic bags and then place them in a crush-proof sealed container, such as a coffee can, plastic margarine tub or plastic beverage bottle.

Department staff will collect the dropped off items at the end of May for consolidation. Staff will then transport the mercury items to Jefferson City to recycle and properly dispose of the rest. A person who is uncomfortable with transporting mercury instruments, or who has large quantities of mercury, can contact the department's spill line at 573-634-2436 to arrange to have items picked up. A list of mercury drop-off location sites is available at dnr.mo.gov/env/esp/mercuryroundup-dnr.htm. Contact the nearest participating agency or DNR's Environmental Services Program at 573-634-2436 for more information.

Neosho Awarded $9.4 Million Low-Interest Loan



The Department of Natural Resources has awarded Neosho a $9.4 million low-interest loan to improve its drinking water system. The city will use the loan to replace aging drinking water distribution lines, provide a backup power supply for the pump stations, upgrade the treatment plant to meet current and future standards and add chemical feed systems to all wells. The project is estimated to cost $9.4 million and is expected to be completed in January 2013.

Funding for the loan comes from the Drinking Water State Revolving Fund. A portion of the money will be targeted toward green infrastructure, water and energy efficiency and environmentally innovative projects.

The department is committed to working closely with communities to assist with funding efforts that support water and wastewater infrastructure improvement projects, as well as provide a financial savings. For more information contact the department's Water Protection Program, Financial Assistance Center, PO Box 176, Jefferson City, Mo. 65102-0176 or call 800-361-4827, or visit the program's website at dnr.mo.gov/env/wpp/srf.

Geologic Maps Published

Five new geologic maps are available for portions of Lincoln and St. Charles counties. The department's Division of Geology and Land Survey created the maps through the STATEMAP component of the National Cooperative Geologic Mapping Pro-

gram, which is co-funded by the U.S. Geological Survey.

Surficial material maps are available for Defiance, Maryknoll and the Winfield quadrangles. Bedrock maps are available for the Wentzville and Maryknoll/Winfield quadrangles.

Bedrock geologic maps provide information about the existing layering of bedrock and faulting, folding or deformation. They include information about the distribution of rock such as limestone, sandstone, coal and granite.

Surficial material maps describe deposits that occur above bedrock. This includes soil, but also details up to several hundred feet of deeper unconsolidated material.

Geologic maps are used in applications including agriculture, water availability, earthquake and other natural hazard evaluation, industrial and commercial development siting, waste disposal facilities and economic assessment of our natural resources.

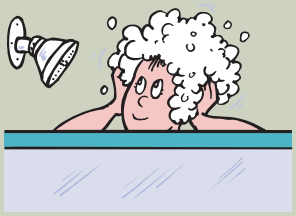
Visit missourigeologystore.com to purchase these or other geologic or topographic maps, or call 573-368-2100. You also can visit the Division of Geology and Land Survey at 111 Fairgrounds Road in Rolla.

Permit Modifications List Available Online

Facilities or businesses that actively treat, store – for more than 90 days – or dispose of hazardous waste in Missouri must get a hazardous waste permit, which lists how and what kinds of hazardous waste the facility can manage. It also lists the facility's operating conditions and closure, corrective action and financial assurance requirements. The department or the facility can make changes to the hazardous waste permit throughout its life. Permit modifications are labeled as Class 1, 2 or 3, depending on how much they change the original permit conditions. The public is invited to review the Department of Natural Resources' list of all approved hazardous waste permit modifications for calendar year 2011. The permit modifications list is online at dnr.mo.gov/env/hwp/permits/publications.htm. For more information or a hardcopy of the list, contact the department's Hazardous Waste Program at 800-361-4827. Hearing- and speech-impaired individuals may reach the department through Relay Missouri at 800-735-2966.

environmental notes

Rub-A-Dub-Dub; Save Water When You Scrub



It seems the jury is out on whether taking a bath rather than a shower uses less water, but if showering is your ritual of choice there are few options to consider. With only one percent of the water on our planet being fresh water, it is easy to see the importance of reducing waste. Conserving our fresh water supply ensures there is plenty to go around and reduces energy used to process wastewater that is washed down the drain. An easy way to save a boatload of water when showering is to borrow some wisdom straight from the U.S. Navy.

On a ship, fresh water is scarce, so conserving what is available is extremely important for the entire crew. Approximately 25 gallons of water per person, per day is required for cooking, drinking, washing and bathing when out at sea. Making fresh water on a naval vessel is also an extremely expensive, inefficient undertaking. The process requires boiling seawater to remove salt. A "Navy shower" is the easiest way for the crew to save water when sailing the seven seas.

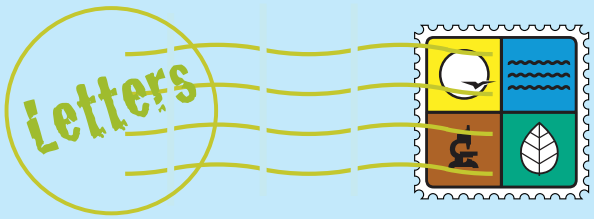
Taking a Navy shower is easy. You begin with an initial 30-second rinse, then shut off the water while soaping and lathering. Finally, the water is turned on for a quick final rinse. In comparison, a standard "Hollywood Shower," where conservation is not a concern, can use as much as 60 gallons of water. A Navy shower can cut water consumption down to as little as 3 gallons of water. While taking one shower a day over a year's time, Navy showers can equate to a savings of approximately 20,000 gallons of water when compared to a standard shower.

While this method may seem a little extreme to most, the principles behind it are sound and can be applied to any daily bathroom routine in a variety of ways. Low-flow showerheads can cut water consumption to as little as one-half gallon per minute. While no special hardware is needed to practice a full-blown Navy shower, a variety of showerheads designed specifically for this purpose can be purchased at most hardware stores. These heads include a cut-off switch for stopping the flow of water without requiring you to re-regulate your water temperature for the final rinse. Other conservation methods include setting a timer so you know how long you've been showering, as well as setting your water heater to 120 F to save energy used to heat water.

Conserving fresh water not only ensures a lasting supply, but also helps to lower the energy cost burden on all citizens. To reach this goal, make an effort to practice good water conservation habits, both at home and at work.

Online Workshops Save Energy for Municipalities

The Missouri Department of Natural Resources offered a series of workshops on building energy codes and standards that could help Missouri municipalities save billions in energy costs. The department's Division of Energy focused its workshops on the residential and commercial building



Once a month, time and weather permitting, we take a short trip – typically one day – to see sites of local historical or scientific interest. While we were aware of the famous meteor crater in Arizona, we had no idea that Missouri also had meteor craters, until the latest issue of *Missouri Resources* arrived.

For each outing, we put together slides of the trip to share with friends and relatives. We enjoy your magazine, especially the articles that bring our attention to something that we can visit with just a day trip from our home in Aurora. A friend later pointed me to the link, missourigeologists.org/, which has some very nice geological guides that I will reference if we get to make a return visit.

These kinds of excursions would make great outings for Boy Scouts and school geological field trips.

Gene Ballay
Aurora

Editor's Note:

Gene attached some great photos from his Decaturville Impact Structure visit. As with any field trip, the department reminds you to respect the rights of private property owners and ask for permission in order to access areas outside public lands, roads and right-of-ways.

Just read through the Winter 2012, "*Missouri Resources*." It has been a lot of years since I walked through the Mark Twain Cave and studied a few geology classes, but on the topic of maze caves, I have to wonder if the cave at Montegaw Springs, might not also qualify as a maze cave? A lot of passages at 90 degrees in that one.

Speaking of caves, your "Time Exposures" asserts that Smallin Cave has the largest opening. Probably, but I was at a cave once to the fairly immediate southeast of Climax Springs, that also had a huge opening. My foggy memory would have it, at least half of the dimensions you cite for Smallin, and substantial in its own right.

I also enjoyed the article on the structures along the 38th parallel. I got to visit the Decaturville dome on a college field trip 40+ years ago. I don't recall at the time that our instructor had connected the dots with the other features stretching from Illinois, over into Kansas. Also then read the Geologists Field Trip Guidebook, 51st Annual Meeting, Rolla, Mo., Oct. 1-2, 2004. So now I'm all up to speed on that topic. Anyway, darn good issue.

David Salmon
Belton

I just read your article, "Extraterrestrial Visitors," in your winter issue, and enjoyed it very much. When I saw the graphic on impact structures, I noticed the site in Kansas was very close to where my "rock" was found. I was an Allen County Commissioner in the 1975 to 80s period, and the road supervisor brought it to me, knowing of my interest in such things. It was found in the county quarry in the rock crusher, which was not able to break it. The combination quarry and landfill is located about 35 miles west of Fort Scott, Kan. I took it to the physics department at Missouri Southern several years ago. The professor examined it, and could not determine its content. It is magnetic, weighs between six and seven pounds and is roughly 3.5 by 2.75 by 2 inches in size. I wonder if it could be a meteorite. Should you have any interest in examining it, please let me know.

Phyllis DeTar
Carl Junction

Editor's Note:

Division of Geology and Land Survey staff in Rolla examined Phyllis's interesting rock and found it too low in nickel to be a meteorite. The abundant, heavy iron content of the stone was a ferrous metal of manmade origin.

What a super issue, Winter 2012. I teach 7th grade Earth Science for NWR1 school district. This issue covers so much that I will be teaching it in March and April. I don't know what your policy is about sending multiple copies. If it is possible, could I have 35 copies to use in my class? I will share them with the other 7th grade teacher, too. If there is a cost involved, please let me know. I love your magazine and read it cover to cover, every issue.

Patty Rosell
Valley Middle School
House Springs

Editor's Note:

We do not charge to deliver extra copies to teachers for classroom use. To minimize waste, we do ask that teachers have the students subscribe to receive the magazine at home, and bring that copy to school for classroom study when requested. This way, the students and their family continue to receive Missouri Resources *after they move to the next grade, and teachers can request a new list each year. Teachers also can access online versions of* Missouri Resources *for classroom use at dnr.mo.gov/magazine.*

Letters intended for publication should be addressed to "Letters," *Missouri Resources,* PO Box 176, Jefferson City, MO 65102-0176 or faxed to (573) 522-6262, attention: "Letters." Please include your name, address and daytime phone number. Space may require us to edit your letter. You also can email *Missouri Resources* staff at moresdnr@dnr.mo.gov.

standards developed for the International Energy Conservation Code. The department selected a team of building experts to provide several workshops from November 2011 through February 2012 in St. Louis, Springfield, Kansas City and Columbia. In addition to the workshops, the department held corresponding webinars. All presentations and webinars can be viewed on our website at dnr.mo.gov/energy/energycodes.htm. For more information about building codes and standards, contact the department's Division of Energy at 573-526-5017 or email energy@dnr.mo.gov.

"Camp Smart" in Missouri State Parks

Missouri State Parks is implementing a green initiative called "Camp Smart" that will help both the state park and campers. This effort encourages visitors to help conserve energy, protect the environment and save money. Reducing energy use will help Missouri State Parks keep camping fees low. During the season, colorful "Camp Smart" decals will appear on campground electric pedestals, providing tips to save energy when visitors are away from their campsite. Every visitor will be able to do their part to help minimize wasted energy at the campground and decrease overall energy consumption. Energy use is a significant cost to operate Missouri state parks. Visit mostateparks.com to learn more about camping in a Missouri state park.

Missouri Natural Areas Celebrate 35th Birthday

Missouri natural areas are celebrating their 35th birthday and the invited guests are visitors to Missouri state parks. Missouri natural areas are recognized as the best remaining examples of our state's original natural environments and are managed and protected for their scientific, educational

Stream Team Notebook

Everybody Wins With Ozarks Water Watch Project

When David Casaletto took the job of Executive Director of Ozarks Water Watch Foundation (OWW), building partnerships was one of his goals. This year, Casaletto has built unprecedented partnerships to obtain data for the Upper White River Basin.

DNR photo by Susan Higgins

From left, Tammy Trantham, Holly Neill and David Casaletto view macroinvertebrates in Roark Creek.

In the past, OWW produced their Status of the Watershed report for the Upper White River Basin using data collected by the United States Geological Survey and science faculty from the University of Arkansas and Missouri State University. However, obtaining this data was expensive and limited the number of sites they could monitor. Casaletto soon began looking for ways to increase the number of sites in order to get a comprehensive view of watershed health. Meanwhile, Holly Neill of the Missouri Stream Team Watershed Coalition (MSTWC) had just finished compiling the State of the Streams report, using macroinvertebrate data collected by Missouri Stream Team volunteers.

"I have been a volunteer with Lakes of Missouri Volunteer Program (LMVP) for years," said Casaletto. "They have a dedicated group of volunteers so I thought we could use volunteers for our data collection."

Not wanting to reinvent the wheel, Casaletto saw a perfect fit with the Stream Team Program. Casaletto and Neill met with Stream Team program staff about recruiting volunteers to monitor in the Upper White River Basin for the Ozarks Water Watch Foundation. Casaletto and Neill then scheduled a meeting with the Department of Natural Resources to see what Water Watch volunteers could do to help.

"It makes sense to produce data that can be used by DNR," said Casaletto. "If they need something that we can provide while we are in the field, why not do it?" After meeting with Water Protection Program staff, Neill and Casaletto learned that the department needed data on high-flow events. Base-flow samples show the pollution from point sources, but a high-flow sample reveals what is entering the stream from non-point sources. A trained volunteer living nearby can easily get to a stream during a rain event to grab a sample.

This year OWW, MSTWC, LMVP, Stream Teams, Table Rock Lake Water Quality, MDC and DNR are partnering toward a common goal. Volunteers will collect samples throughout the recreational season. The LMVP lab will do nutrient analysis for the project.

Everybody wins when we work together to protect our natural resources.

Time Exposures

In 1904, the Louisiana Purchase Exposition, also known as the St. Louis World's Fair, began after a delayed opening in 1903. The fair took place on what are now the grounds of Forest Park and Washington University and was the largest World's Fair to date. Approximately 1,500 temporary buildings were constructed of a plaster of Paris and hemp fiber mixture called "staff," as well as almost 75 miles of walkways and roads within the fairgrounds. It was said that it was impossible to see the entire fair in less than a week.

The fair included exhibits from 62 foreign countries, as well as the then 45 U.S. states, and featured anything from educational and scientific displays to demonstrations of new industries, theater troupes and music. It has even been claimed that the waffle-style ice cream cone was invented and made popular at the fair.

The photo above is a stereograph image taken from a view that looks down the West Cascade and across Grand Basin on the fairgrounds. Every minute, 45,000 gallons of water would flow down the Cascades and into Grand Basin. The building in the distance is the Palace of Education and Social Economy that covered eight acres on the east side of the Basin. Inside the palace were live displays of actual classes in session, ranging from kindergarten to university courses, as well as exhibits exploring pressing issues like housing, labor and health. This image is part of a collection of stereographs published by the H.C. White Co., Bennington, Vt., and resides in the Library of Congress' stereograph card collection.

Send your photo to "Time Exposures," c/o Missouri Resources, PO Box 176, Jefferson City, MO 65102-0176. Original photos will be returned via insured mail. Pre-1970 environmental and natural resource photos from Missouri will be considered. Please try to include the date and location of the picture, a brief description and any related historic details that might be of interest to our readers.

and historical values. The Missouri Natural Areas Program was first established in 1977 as a multi-agency committee to identify and protect these areas all across the state.

In Missouri state parks, there are 38 designated natural areas encompassing almost 22,000 acres. Natural areas do more than preserve natural landscapes – they also provide hiking trails and other recreation opportunities.

Here are several natural areas with numerous trails to experience. Regal Tallgrass Prairie Natural Area at Prairie State Park offers an opportunity to experience the grandeur and vastness of the tallgrass prairie and all the plants and animals that live there, including bison, elk and prairie chicken. Elephant Rocks Natural Area in Elephant Rocks State Park makes a big impression with huge pink granite boulders strewn across a few acres like a giant natural playground. Lincoln Hills Natural Area at Cuivre River State Park shows visitors a little bit of the northern Missouri historic mixture of prairie, savanna, woodlands, glades, sinkholes, bluffs and streams. Mudlick Natural Area in Sam A. Baker State Park is a complex of old-growth forests, open woodlands, deep canyons, igneous cliffs, glades and the impressive Mudlick Mountain.

For more information on Missouri state park natural areas, visit mostateparks.com.

Energy-Efficiency Measures in State Parks

Missouri State Parks is pursuing green practices to reduce energy costs in the state park system. These cost-saving and energy-reducing practices currently are being implemented at three parks in Missouri.

Funds from the federal American Recovery and Reinvestment Act helped identify and implement comprehensive energy-saving projects at Bennett Spring, Roaring River and Meramec state parks. Each project uses state-of-the-art photovoltaic panels, high SEER (Seasonal Energy Efficiency Rating) heating and cooling systems, high-efficiency water heaters, smart electronic control systems and state-of-the-art lighting technology. These projects allow Missouri State Parks to show visitors what energy-efficiency measures can be implemented in their own home or business.

For news releases on the Web, visit: dnr.mo.gov/newsrel/.

For a complete listing of the department's upcoming meetings, hearings and events, visit the department's online calendar at: dnr.mo.gov/calendar/search.do.

Looking for a job in natural resources? Go to: dnr.mo.gov/hr/.

Resource Honor Roll **Central High School**

What began with a *Newsweek* article eventually led to change at Central High School in Springfield, Mo. Students in the school's television production program produced a story for *Central Intelligence* that took a close look at the air quality around their southwest Missouri school.

"Students did 100 percent of the research from there," said Nichole Lemmon, faculty advisor for the Central High School's biweekly television show, *Central Intelligence*. Student producers Lydia Berns and Mitchell Trafford gathered information on which pollutants were floating in the air around their high school campus and examined the threats they could pose to classmates and teachers. They even interviewed a local physician on camera for information on possible health risks.

The segment, "Alarming Air," has brought real change to the campus of Central High School. "The story was really big in our community. We received lots of attention," said Lemmon. "Since the story aired, our school has really vamped up our Green Team and has worked to create more green space around our buildings."

When a retired administration building on campus was demolished, the decision was made to leave the area as green space instead of turning it into a parking lot. There also is an active greenhouse on campus where plants are grown for replanting throughout classroom buildings, helping to clean the school's air of harmful pollutants. The video segment was so well produced that it also won an award from the National Academy of Television Arts and Sciences, Mid-America Emmy Association. The association gives 15 high school awards each spring, and "Alarming Air" took the news category prize. In addition, it was awarded the National Scholastic Press Association's 2010 "News Story of the Year" award.

Nichole Lemmon photo

Mitchell Trafford and Lydia Berns of Central High School, Springfield.

Central Intelligence has won a total of 18 student Emmy awards in the last three years, including "Best Overall Show" in 2011, which is more than any school in the U.S. Most recently, *Central Intelligence* also took "Best of Show" at the 2011 National Scholastic Press Association's national convention, as well as their third consecutive "Pacemaker Award." For more information about *Central Intelligence* and to view "Alarming Air," head to their website at www.chsci.com.

Rock Matters

Fireclay

The abundance of clay-rich sedimentary rock, known as fireclay, enabled 19th century brick makers in St. Louis, Mexico, Fulton and other regions of Missouri to manufacture large quantities of brick and firebrick for worldwide use. Photo by ANH Refractories

Fireclay is a clay-rich sedimentary rock that contains a high percentage of aluminum oxide, which makes it very resistant to the effects of high temperatures. It is usually massive (not laminated or layered) and fractures into blocky or irregular fragments. Common colors include buff, yellow, red, green or brown. However, good, useable fireclay is usually white, cream-colored, gray, or almost black. The four types of fireclay (each progressively higher in aluminum oxide or alumina content) are:

Plastic clay – soft and, when wet, has the characteristics of a modeling clay.

Flint clay – compact, smooth, and usually gray, tan or white in color. It will not slake or "dissolve" in water like plastic clay.

Burley clay – similar to flint clay but contains many small, hard, pod-like "burls" which are concentrations of alumina. These burls are hard enough to scratch glass.

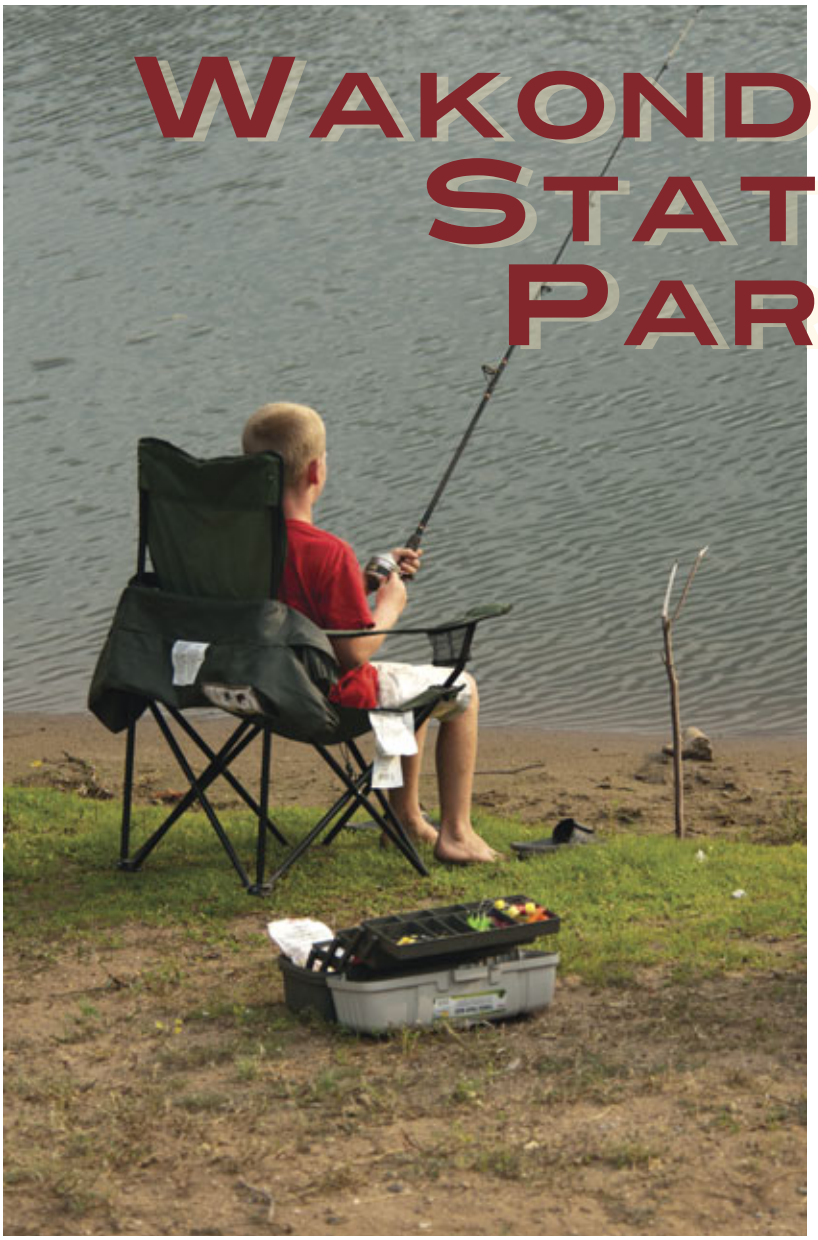
Diaspore clay – the richest in alumina and is commonly buff colored, earthy and coarse, with burls concentrated in a porous matrix. It is very rough to the touch.

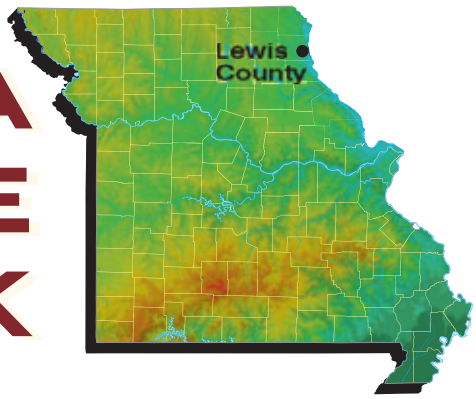
East-central Missouri possesses one of the largest reserves of high-quality fireclay in the world. Most Missouri fireclays can withstand being heated to temperatures greater than 3000° F without melting. Refractory products made from fireclay are of vital importance to the steel industry as linings in blast furnaces, kilns, fireboxes, fireplaces and to the space program for missile platforms or launching pads. Fireclay is also used as an additive in the manufacture of cement. It reacts with calcium hydroxide as concrete hardens and forms compounds that have the properties of cement.

Visit the department's Ed Clark Museum of Missouri Geology at: dnr.mo.gov/geology/edclarkmuseum.htm, located in Rolla at 111 Fairgrounds Road, where you will find fireclay and other rocks, minerals and fossils.

DNR photos by Mark Gordon

Wakonda State Park





by Missouri State Parks staff
photographs by Scott Myers

(Above) Wakonda State Park's six lakes provide ample opportunities to spend the day fishing. (Right) Wakonda's five biking and hiking trails offer lots of room for outdoor recreation in a scenic setting.

Wakonda State Park, near La Grange, spans 1,050 acres and encompasses six lakes, providing a variety of opportunities for visitors.

"Our park has something for everyone," said Kyle Scott, superintendent of Wakonda State Park. "In the summer, swimming, camping and boating are popular and during the spring and fall migrations, it is a great place for bird-watching."

Wakonda State Park traces its natural history to the melting of the great Pleistocene glaciers more than 10,000 years ago. Torrents of melt water cut deeply into the soils beneath, flushing glacier-derived gravel and sand downstream. There, the rocky remains began to spill onto expansive sandbars and gravel deposits within the Mississippi River valley. One particularly large gravel deposit formed in northeast Missouri near present-day La Grange.

Gravel became a desired commodity following World War I and the rise of the automobile. These large deposits provided an excellent resource for the Missouri Highway Commission to help convert dirt roads to a surface more suitable for automobile traffic. During 1930-1965, approximately 16 million tons of surfacing gravel from this area were applied to roads around the state. This gravel covered 24,300 miles of secondary roadway throughout rural Missouri. In the process, several lakes and rolling gravel hills were left behind.

In 1960, after years of mining gravel from these deposits, the Missouri Highway Commission turned the area over to the Missouri State Park Board. In 1967, construction began on Wakonda State Park.

Wakonda has a diverse mix of recreational amenities. On summer weekends, it is

common to find a bustling beach and campground. Visitors have the opportunity to picnic or bring their children to one of the three playgrounds. The park provides excellent water recreation opportunities and is a great place for the casual sightseer, photographer or bird-watcher.

The early gravel mining operation created six lakes and several wetland areas in the park. This provides an array of water activities for park visitors and an outstanding place to see waterfowl and wading birds. During migration, various waterfowl can often be seen in large numbers.

The four most popular lakes are Wakonda, Jasper, Agate and Boulder. All provide many fun ways to spend your day. Jon boats and kayaks can be rented at the park office. Wakonda Lake and Agate Lake allow motor boats with speed restrictions.

Wakonda Lake spans 78 acres and provides the largest natural sand beach in the state park system. Additionally, the beach front offers a snack area with vending machines. If lying on the sand or floating in the water isn't your speed, the beach offers volleyball and horseshoes to enjoy a beautiful Missouri day. Wakonda Lake maintains a concrete boat ramp and dock. You can reserve a campsite near the lake to relax on a northeast Missouri evening.

Agate Lake is the largest of the six lakes and spans 168 acres. Agate Lake includes a concrete boat ramp and the fishing dock offers a great place to cast your pole to catch bass or bluegill. After you fish for awhile, take in the scenery or enjoy lunch at a lakeside picnic table.

Both Jasper and Agate lake serve as waterfowl refuges during the spring and fall migration, November through January and February through March each year. As a result of the protected habitat, these seasons provide great opportunities to view wading birds, waterfowl and shorebirds. To help facilitate waterfowl migration in the area, Agate Lake closes on Nov. 1.

Boulder Lake is a 20-acre impoundment that offers fishing and allows boats with electric motors. Wrapping around the lake is the Boulder Lake campground. The camping sites offer a great view of the lake as well as a shower house, laundry facilities and a playground.

(Top) Wakonda's lakes offer a vast array of recreational options, from beach volleyball to swimming and water sports. Check at the park to see which type of boats are allowed on the individual lakes.
(Below) Wakonda Lake campground offers large, paved campsites with all the amenities, including water, sewer and electric hook-ups for recreational vehicles.

Five biking and hiking trails are found throughout the park. These trails vary in length from just under one-half mile to the longest trail – three and one-half miles – which runs along the shore of Agate Lake. An additional one-mile trail leads through the sand prairie.

"Our location along the Highway 61 corridor provides a great day-trip destination, as well as an excellent place to camp for a few nights," said Scott.

The park offers a great array of recreational amenities, but it also offers a diverse natural setting to explore.

One highlight is its rare sand prairie. The dredging activities that took place in the early 1900s left behind man-made mounds of sand and gravel that were in close proximity to natural sand prairies along the Mississippi River. Plants from those prairies colonized the mounds, and even though the original sand prairies have long since become farmland, the plants from them are preserved as a special park feature.

Wakonda State Park is home to two such sand prairies, which together encompass 151 acres. Using special protection and periodic prescribed burns, park staff have been able to preserve native Mississippi River sand prairie plants including sand dropseed, Schweinitz's flatsedge, evening primrose, cottongrass, flowering spurge and sandgrass.

They also have collected and added seeds from other unique sand prairie species found along nearby roads and field borders, thus adding plants such as hoary puccoon, lead plant, spotted bee balm, little bluestem, false sunflower, round-headed prairie clover and gray-headed coneflower. These two prairie preserves are great places to view both native prairie plants and grassland birds.

In addition to the sand prairie, the park is home to small wetlands, forest grasslands and ponds that hold surprisingly diverse arrays of native plants, birds and wildlife. It's especially impressive in the spring and fall migrations to find American white pelicans, geese, ducks, gulls, hawks and even bald eagles. Some wading birds such as blue herons and great egrets also can be observed and photographed.

"Wakonda State Park offers a great place to explore nature, especially the rare sand prairie," said Scott.

Wakonda State Park is located three miles south of La Grange on State Park Road. For information about Wakonda State Park, call the park at 573-655-2280 or visit mostateparks.com.

This story was a collaborative effort of staff from Missouri State Parks, a division of the Missouri Department of Natural Resources.

With its six lakes and 7.2 miles of trails, Wakonda State Park offers numerous avenues for visiting and enjoying the peace and beauty of the outdoors.

Terri Zumalt

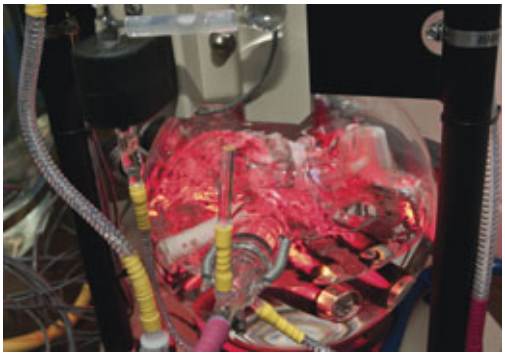
Lab Life is Testing

by Victoria Lovejoy
photographs by Scott Myers

Red glowing lights, bubbling beakers and fluid dripping through tubes lie behind the door marked, "Volatiles Lab," at the Missouri Department of Natural Resources' Environmental Services Program.

The program's Chemical Analysis Section staffs the state's only environmental laboratory. Each year, the section tests thousands of samples for volatiles, a class of organic compounds which easily become gaseous at room temperature. Some volatiles are known or suspected carcinogens. Volatile can also mean lively and lighthearted. Amid samples that are purged by bubbling helium, laughter bubbles now and then from chemist Terri Zumalt when she explains her work as one of several chemists who analyze volatiles.

"One of the most important things is that samples have to be filled to the top so there is no room for air," Zumalt said, then chuckles. "We call that 'free of head space.' Volatile compounds have low water solubility and prefer to be in the form of a gas."



Zumalt moved from pushing pizzas and paper routes to pushing paper as an office secretary with the Missouri Jaycees in 1982. In 1983 she was hired by the Department of Natural Resources as a clerk typist, eventually joining the staff at the Environmental Services Program. This change marked a turning point. She began taking night classes at Columbia College.

"I was surrounded by environmental specialists, chemists and air quality staff," said Zumalt. "I was so inspired by Cindy Davies and Carrie Schulte because, while they were working as laboratory technicians, they also studied chemistry at Lincoln University. I thought that is so interesting. I can do that!"

Schulte is now an environmental specialist with the department's Water Pollution Control Program, and Davies is the director of the department's Southwest Regional Office in Springfield.

(Above) Chemist Terri Zumalt of the department's Environmental Services Program calibrates testing equipment before running samples.
(Left) Water is distilled to obtain the purist fraction of contaminant-free, reagent-grade water.

"I remember when Terri started working at ESP many years ago, and I am so proud of her accomplishments," Davies said. "It is extremely difficult to juggle work, school and family but the flexibility shown by the ESP in allowing adjusted work schedules to attend classes, and the encouragement that department staff provide to those trying to improve themselves go a long way in making it possible."

Working full time and juggling classes was not easy but with the support of her husband, Keith, who made grilled cheese on test nights, Zumalt eventually graduated magna cum laude. She received her Bachelor of Science in chemistry from Lincoln University in 2005.

Before transferring to the volatiles lab, Zumalt spent many years working behind a door marked, "Organic Prep Lab," and another door, "Organic Extractables Lab," with Tarun Choudhury, Ph.D. She appreciated the encouragement that he provided while Choudhury found enjoyment in her "volatile" personality.

"It was a lot of fun working with Terri in the organic labs," Choudhury said. "She was very enthusiastic about learning new things. When it came to learning, Terri Zumalt was tireless."

One instrument Zumalt mastered is the gas chromatograph mass spectrometer. The instrument is one of the tools used to identify and measure volatiles. Using this method of analysis enables the laboratory to detect volatiles at extremely low concentrations.

The Chemical Analysis Section provides support for programs throughout the department and for other state agencies. Through analysis, section staff identify and confirm the presence of natural and man-made pollutants. The section performed more than 74,000 individual tests during fiscal year 2011, which kept scientists in the lab most of the time. Sharing lab space is easy, according to Doug Vogel, another volatiles lab scientist. Vogel compares Zumalt to the unsinkable Molly Brown.

"She is always up in spirit, nothing gets her down," said Vogel. "I can depend on her to have a smile on her face. It's nice to have cheerful company in the lab."

Doing important work with people she cares about has obviously made Zumalt happy that her choices led her to see what was waiting behind the various laboratory doors at the state environmental lab.

Visit dnr.mo.gov for information about the Environmental Services Program and for information about other career opportunities, visit the Office of Administration's website: oa.mo.gov/pers/.

Victoria Lovejoy is a public information specialist in the department's Environmental Services Program.

Zumalt prepares a mass spectrometer in the lab. Mass spectrometers are used to identify chemical compounds based on their fragmentation patterns.

one last word

Our Official State Symbols

Geology

by Hylan Beydler

Missouri became a state in 1821 and since then, various symbols have been selected to identify our unique geology and history. Learn more about Missouri geology online at: dnr.mo.gov/geology.

State Rock Mozarkite

DNR photo by Mark Gordon

Mozarkite is a special variety of chert that is typically red, pink, and purple with varying tints of green or gray. The word Mozarkite is a contraction of "Mo," for Missouri; "zark," for Ozarks; and "ite," meaning rock. Found only in Missouri, Mozarkite consists essentially of quartz minerals. The rock's beauty is enhanced by cutting and polishing for jewelry. The most abundant deposits are found in west-central Missouri, south of the Missouri River.

The Mozarkite Society of Lincoln, in Benton County, promotes awareness and education about Mozarkite and the interest in the study of mineralogy, lapidary and jewelry. Legend suggests it may have been fiercely protected by the Osage Indians as the beautiful stone is a form of flint and would have made attractive points and tools.

State Fossil Crinoid

DNR photo by Hylan Beydler

The fossil crinoid is a mineralization of an animal which, because of its plant-like appearance, is often called a sea lily. Related to the starfish and sand dollar, *Delocrinus missouriensis* lived in the ocean that once covered Missouri. They used their stem-like extensions to attach themselves to the sea floor. Preserved as fossils, these extensions – which were made of round disks stacked together – were used by Native Americans as beads.

Disks can still be found today. Occasionally, a searcher may find the "cup" or "calyx," which protected the animal's soft body with a symmetrical petal pattern of calcium-rich plates atop the stem. Hundreds of species of crinoids exist in the warm, clear waters of the Pacific and Indian oceans, as well as the Caribbean Sea.

State Mineral Galena

DNR photo by Hylan Beydler

Galena, a natural semiconductor used in early wireless communication systems, played a major role in advancement of the electronic tools and conveniences we enjoy today, from cell phones and TVs to GPS systems and medical equipment. A bluish-gray metallic luster identifies galena. Often mined for its silver, galena is the primary ore of lead. It is the most abundant and widely distributed sulfide mineral. Major deposits have been mined in southeast Missouri almost continuously since 1720. Galena aptly symbolizes Missouri's position as the premier producer of lead in the United States and the world. Galena has found notoriety in the "green technology" arena. The essential element is sprayed as a thin layer on a solar panel and acts as a semiconductor.

State Dinosaur Hypsibema missouriensis

Hypsibema missouriensis lived in Missouri during the late Cretaceous period near the end of the Age of Dinosaurs. These plant-eaters walked on all fours, reached lengths of thirty-five feet, and probably equaled the weight of two cars. They sported 1,000 teeth able to handle the tough, fibrous vegetation of the time. It was discovered in 1942 when Missouri Geological Survey geologist Dan Stewart was investigating clay deposits near the Bollinger County town of Glen Allen. A local family told Stewart about clay they had encountered in a recently dug well. Upon arriving at the location, he was shown bones that had been found in the clay. These bones were sold to the Smithsonian Institution but it was not until the 1980s that the "duck-billed" dinosaur was correctly identified as a hadrosaur.

See the back cover of this issue of *Missouri Resources* for a close-up look at this toothy vegetarian. The full-size replica was created by Guy Darrough of Lost World Studios in Arnold, Mo. Learn more at: lostworldstudios.com.

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